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Automatic Tracking of Red Blood Cells in Micro Channels using OpenCV

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Abstract. The present study aims to developan automatic method able to track red blood cells (RBCs) trajectories flowing through a microchannel using the Open Source Computer Vision (OpenCV). The developed method is based on optical flux calculation assisted by the maximization of the template-matching product. The experimental results show a good functional performance of this method.

Keywords: Red blood cells.Blood flow. Tracking. Optical flow. Template-matching. OpenCV.

INTRODUCTION

Several studies in clinical observations and experiments studies, abnormal microscopic blood flow behaviors are often associated with several disorders and diseases, such as hypertension, anemia, diabetes, cancer and malaria[1-4]. Therefore, microcirculation has attracted extensive interests and broad studies have been conducted with the help of the advances in experimental and computational techniques to provide a better understanding on the blood disorders in microcirculation. An automatic cell tracking method can be used to acquire some cell features that can change along the trajectories making it possible to diagnose several microvascular diseases.

In this study, it is presentedan automatic tracking method able to compute automatically red blood cells (RBCs) trajectories using OpenCV[5],in orderto minimize user errors and shorten handling time when compared to the traditional manual methods.

MATERIALS AND METHODS

Experimental Set-up

The physiological fluid examined was composed of Dextran 40 (Dx40) containing ~1% of human RBCs. The blood samples were submitted to washing and centrifuging processes and were stored hermetically at 4ºC until the experiments were performed at temperature of ~37ºC. All procedures were carried out in compliance with the guidelines of the Ethics Committee on Clinical Investigation of Tohoku University.For the microfluidic experiments, the microchannels were placed on the stage of an inverted microscope (IX71, Olympus, Japan) and the temperature of the stage was adjusted by means of a thermo plate controller (Tokai Hit, Japan) to 37ºC. The flow rate of the working fluids was controlled by using a syringe pump (KD Scientific Inc., USA).The images of the flowing RBC's were captured using a high speed camera (Phantom v7.1, Vision Research, USA) and transferred to a computer to be analyzed.Detailed description of the samples preparation and high-speed video microscopy system can be found elsewhere[6, 7].

The data obtained from experiments are the digital video sequences captured at the frame rate of 1000 frames/s with an exposure time of 20 μs, with frame intervals of 1000 μs and with resolution of static images 800 x 600 pixels each.

The microchannel containing the hyperbolic contraction was produced in polydimethylsiloxane (PDMS) using standard soft-lithography techniques from a SU-8 photoresist mold.More detailed description can be found elsewhere[6].

The geometry and dimensionsof the micro-fabricated channel analyzed ispresent in Figure 1.

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